



5.4.9 Wildfire

The following section provides the hazard profile (hazard description, location, extent, previous occurrences and losses, probability of future occurrences, and impact of climate change) and vulnerability assessment for the wildfire hazard in Morris County.

2015 HMP update Changes

- The hazard profile has been significantly enhanced to include a detailed hazard description, location, extent, previous occurrences, probability of future occurrence, and potential change in climate and its impacts on the wildfire hazard is discussed. The wildfire hazard is now located in Section 5 of the plan update.
- New and updated figures from federal and state agencies are incorporated.
- Previous occurrences were updated with events that occurred between 2010 and 2014.
- A vulnerability assessment was conducted for the wildfire hazard and it now directly follows the hazard profile.

5.4.9.1 Profile

Hazard Description

A wildland fire can be defined as any non-structural fire that occurs in the wildland. Three distinct types of wildland fires have been defined and include: naturally occurring wildfire, human-caused wildfire, and prescribed fire. Many of these are highly destructive and can be difficult to control. They occur in forested, semi-forested, or less developed areas. Wildland fires can be caused by lightning, human carelessness, and arson. Most frequently, wildland fires in the State of New Jersey are caused by humans. Wildfires result in the uncontrolled destruction of forests, brush, field crops, grasslands, real estate, and personal property, and have secondary impacts on other hazards such as flooding, by removing vegetation and destroying watersheds.

Wildfires can increase the probability of other natural disasters, specifically floods and mudflows. Wildfires, particular large-scale fires, can dramatically alter the terrain and ground conditions, making land already devastated by fire susceptible to floods. Lands impacted by wildfire increase the risk of flooding and mudflow in those areas impacted by wildfire. Normally, vegetation absorbs rainfall, reducing runoff. However, wildfires leave the ground charred, barren, and unable to absorb water; thus, creating conditions perfect for flash flooding and mudflows. Flood risk in these impacted areas remain significantly higher until vegetation is restored, which can take up to five years after a wildfire (FEMA 2013).

Flooding after a wildfire is often more severe, as debris and ash left from the fire can form mudflows. During and after a rain event, as water moves across charred and denuded ground, it can also pick up soil and sediment and carry it in a stream of floodwaters. These mudflows have the potential to cause significant damage to impacted areas. Areas directly affected by fires and those located below or downstream of burn areas are most at risk for flooding (FEMA 2013). For detailed information regarding flooding, see Section 5.4.6 (Flood).

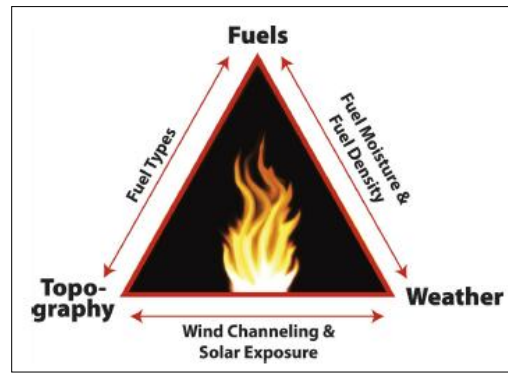
The height of wildland fire season in New Jersey is typically in spring (March through May) and culminates in early May, corresponding with the driest live fuel moisture periods of the year. Although the spring months are the most severe, the summer and fall months may also experience extensive fires in the state. While the spring season is historically the period in which wildfire danger is the highest, wildland fires can occur every month of the year. Drought, snow pack, and local weather conditions can expand the length of the fire season. The early and late shoulders of the fire season usually are associated with human-caused fires. Lightning generally is the cause of most fires in the peak season.



In the State of New Jersey, each year an average of 1,500 wildfires damage or destroy 7,000 acres of the state's forests. Wildfires not only damage woodlands, but threaten homeowners who live within or adjacent to forest environments. From January 1, 2014, to October 19, 2014, there were 780 wildfires in New Jersey that burned 6,438.75 acres (NJFFS 2014).

Fire Ecology and Wildfire Behavior

The “wildfire behavior triangle” illustrates how three primary factors influence wildfire behavior: fuel, topography, and weather. Each point of the triangle represents one of the three factors; the sides represent the interplay between the factors. For example, drier and warmer weather combined with dense fuel loads and steeper slopes will cause more hazardous fires than light fuels on flat ground.



A fire needs all of the following three elements in the right combination to start and grow: a heat source, fuel, and oxygen. The growth of the fire primarily depends on the characteristics of available fuel, weather conditions, and terrain. Climate change is also considered a potential source of influence. These four factors are described below:

- Fuel
 - Lighter fuels such as grasses, leaves, and needles quickly expel moisture and burn rapidly, while heavier fuels such as tree branches, logs, and trunks take more time to warm and ignite.
 - Snags and hazard trees—especially those that are diseased, dying, or dead—are quickly engulfed and allow fires to spread quickly.
- Weather
 - Strong winds within the vicinity of the flames produce extreme fire conditions. Of particular concern are wind events that potentially persist for longer periods of time, or ones with significant wind speeds, which can sustain and quickly promote the spread of fire through movement of embers or exposure within tree crowns.
 - Spring and summer months, which can experience drought-like conditions extending beyond the normal season, also expand the average fire season. Likewise, the passage of a dry, cold front through the region can result in a sudden increase in wind speeds and a change in wind direction affecting fire spread.
 - Thunderstorm activity, which typically begins with wet storms, turns dry with little or no precipitation reaching the ground as the seasons progress.
- Terrain
 - Regional and local topography influence the amount and moisture of fuel.
 - Barriers such as highways and lakes can affect the spread of fire.
 - Elevation and slope of landforms affect fire spread; flames move more easily uphill than downhill.
- Changes to Environment
 - Without an increase in summer precipitation (greater than any predicted by climate models), areas susceptible to future burning are very likely to increase.
 - Infestation from insects is also of concern as it may impact forest health. Potential insect populations may increase with warmer temperatures as a result of warmer temperatures. Infested, stressed trees increase the fuel load.
 - Tree species composition will change as species respond uniquely to a changing climate.



- Wildfires cause both short-term and long-term losses. Short-term losses can include destruction of timber, wildlife habitat, scenic vistas, and watersheds. Long-term effects include smaller timber harvests, reduced access to affected recreational areas, and the destruction of cultural and economic resources and community infrastructure.

NJFFS, a division of NJDEP, is responsible for protecting the 3.25 million acres of wildland in the state. NJFFS is under the direction of the state fire warden and is headquartered in Trenton. NJFFS has 85 full-time employees that provide an array of services including staffing the state's 21 fire towers, which are operational during the months of March, April, May, October, and November.

Location

The NJFFS is broken up into three divisions (A, B, C). Each division is responsible for responding to wildfire events within their boundaries. Morris County is located in Division A. All of Morris County is susceptible to wildfire and they can occur anywhere in the County. Additionally, a portion of Morris County is located within the New Jersey Highlands Regions (New Jersey Highlands). The New Jersey Highlands is an area of 859,358 acres located in northwest New Jersey and includes 88 municipalities and parts of seven counties (Bergen, Hunterdon, Morris, Passaic, Somerset, Sussex, and Warren). The New Jersey Highlands Region serves as a significant green belt along the eastern coast. Forests comprise 47% of the Highland's landscape and is predominately hardwood forests, which provides a fuel hazard for wildfires.

NJFFS has developed Wildfire Fuel Hazard data for the state based upon NJDEP's 2002 Land Use/Land Cover (LU/LC) datasets and NJDEP's 2002 10-meter Digital Elevation Grid datasets. NJFFS took the NJDEP Modified Anderson LU/LC Classification System 2002 and assigned Wildfire Fuel Hazard rankings to it. NJFFS used NJDEP's 2002 10-meter Digital Elevation Grids and calculated areas of 30% or greater slope throughout New Jersey. For areas of Wildfire Fuel Hazard with a ranking of 1 to 4 (i.e. "Low" to "Very High") that were coincident with areas of 30% or greater slope, the Wildfire Fuel Hazard Ranking was increased by one value (i.e. "Low" was increased to "Moderate", "Moderate" to "High", etc.). For areas of Wildfire Fuel Hazard with a ranking of 0, and 5 through 8, the Wildfire Fuel Hazard ranking remained the same. Once the LU/LC was coded according to the Wildfire Fuel Hazard, taking into account 30% or greater slopes, the data were divided by county. This project for Morris County was completed in May 2009. Figure 5.4.9-1 and Figure 5.4.9-2 illustrate the wildfire fuel hazard and wildfire risk for Morris County. For details of these figures, please refer to: http://www.state.nj.us/dep/parksandforests/fire/wildfire_hazard_mitigation.htm A majority of the county has low fuel hazard and low risk. Every municipality in Morris County has at least a small portion of the community located within the high to extreme risk area, with Chester Township having largest percentage of land within the high to extreme risk area (9.7%). Table 5.4.9-1 indicates the amount of land in each of the wildfire fuel hazard ranking zones for Morris County. Table 5.4.9-2 explains the approximate area in the NJFFS risk areas in the County.

Table 5.4.9-1. Area in the Wildfire Fuel Hazard Ranking Zones in Morris County

Hazard Area	Area (Square Miles)
Extreme	4.0
Very High	3.6
High	10.1
Moderate	75.8
Low	218.4

Source: NJFFS 2013



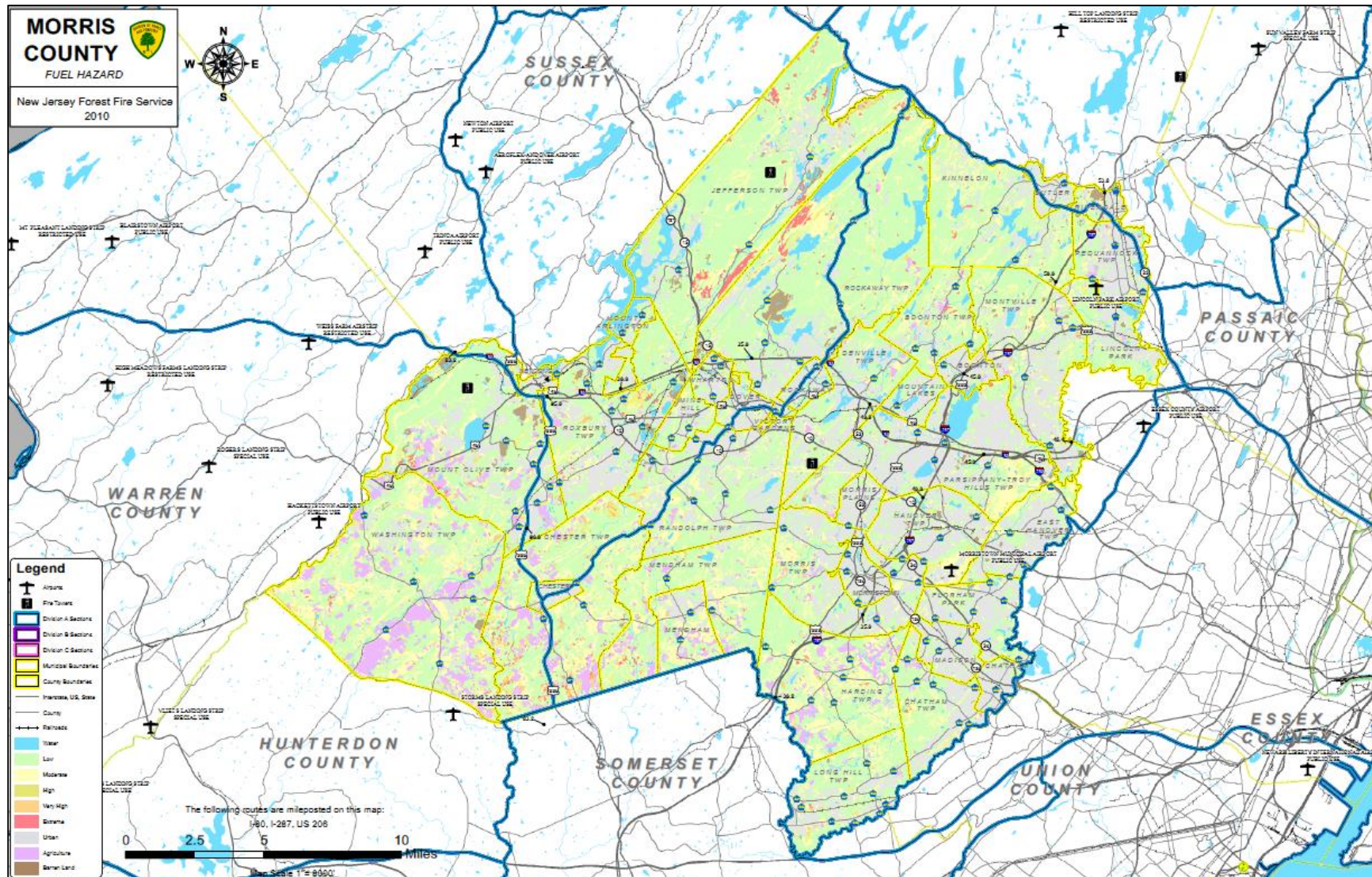
Table 5.4.9-2. Approximate Area in Wildfire Fuel Hazard Ranking Zones in Morris County

Municipality	Total Area (Square Miles)	New Jersey Forest Fire Service Risk Areas			
		Low to Moderate	% in Hazard Area	High to Extreme	% in Hazard Area
Town of Boonton	2.5	0.6	23.7%	0.1	5.0%
Township of Boonton	8.5	6.4	75.3%	0.2	2.9%
Borough of Butler	2.1	0.5	25.8%	0.0	0.9%
Chatham Borough	2.4	0.6	25.7%	0.0	0.9%
Chatham Township	9.3	5.8	62.5%	0.2	2.3%
Chester Borough	1.6	0.6	40.6%	0.1	4.4%
Chester Township	29.1	21.7	74.5%	2.8	9.7%
Denville Township	12.7	7.0	54.8%	0.1	1.2%
Town of Dover	2.7	0.8	29.3%	0.0	1.4%
Township of East Hanover	8.1	3.5	43.8%	0.1	1.2%
Borough of Florham Park	7.5	3.2	43.0%	0.1	1.1%
Township of Hanover	10.7	4.0	37.1%	0.4	3.9%
Township of Harding	20.6	16.7	81.4%	0.5	2.3%
Township of Jefferson	41.9	30.7	73.4%	2.2	5.2%
Borough of Kinnelon	19.2	14.9	77.5%	0.4	2.2%
Borough of Lincoln Park	6.9	4.0	57.2%	0.2	2.7%
Township of Long Hill	12.0	8.2	67.7%	0.4	3.1%
Borough of Madison	4.3	1.0	24.1%	0.1	1.9%
Borough of Mendham	6.0	3.8	63.4%	0.1	2.4%
Township of Mendham	18.0	14.8	82.2%	0.7	3.8%
Township of Mine Hill	3.0	1.8	58.6%	0.0	1.3%
Township of Montville	19.1	10.9	56.8%	0.5	2.6%
Borough of Morris Plains	2.6	0.7	28.4%	0.0	0.7%
Township of Morris	15.8	7.9	50.2%	0.4	2.4%
Town of Morristown	3.0	0.7	24.2%	0.0	0.2%
Borough of Mount Arlington	2.8	1.1	37.7%	0.1	1.8%
Township of Mount Olive	31.2	19.0	61.0%	1.3	4.2%
Borough of Mountain Lakes	2.9	1.2	42.9%	0.0	0.3%
Netcong Borough	0.9	0.2	25.6%	0.0	0.3%
Township of Parsippany-Troy Hills	25.3	10.1	39.7%	0.8	3.0%
Township of Pequannock	7.1	2.7	38.5%	0.2	2.3%
Township of Randolph	21.2	12.1	57.1%	0.5	2.4%
Borough of Riverdale	2.1	0.7	36.1%	0.1	4.1%
Borough of Rockaway	2.1	0.6	29.0%	0.0	1.0%
Township of Rockaway	45.8	32.4	70.8%	1.8	3.9%
Township of Roxbury	21.9	12.0	54.9%	1.3	5.8%
Borough of Victory Gardens	0.1	0.0	4.3%	0.0	0.4%
Township of Washington	44.6	30.3	67.9%	2.0	4.4%
Borough of Wharton	2.1	0.8	35.6%	0.1	2.7%
Morris County (Total)	479.8	294.2	61.3%	17.8	3.7%

Source: NJFFS 2013



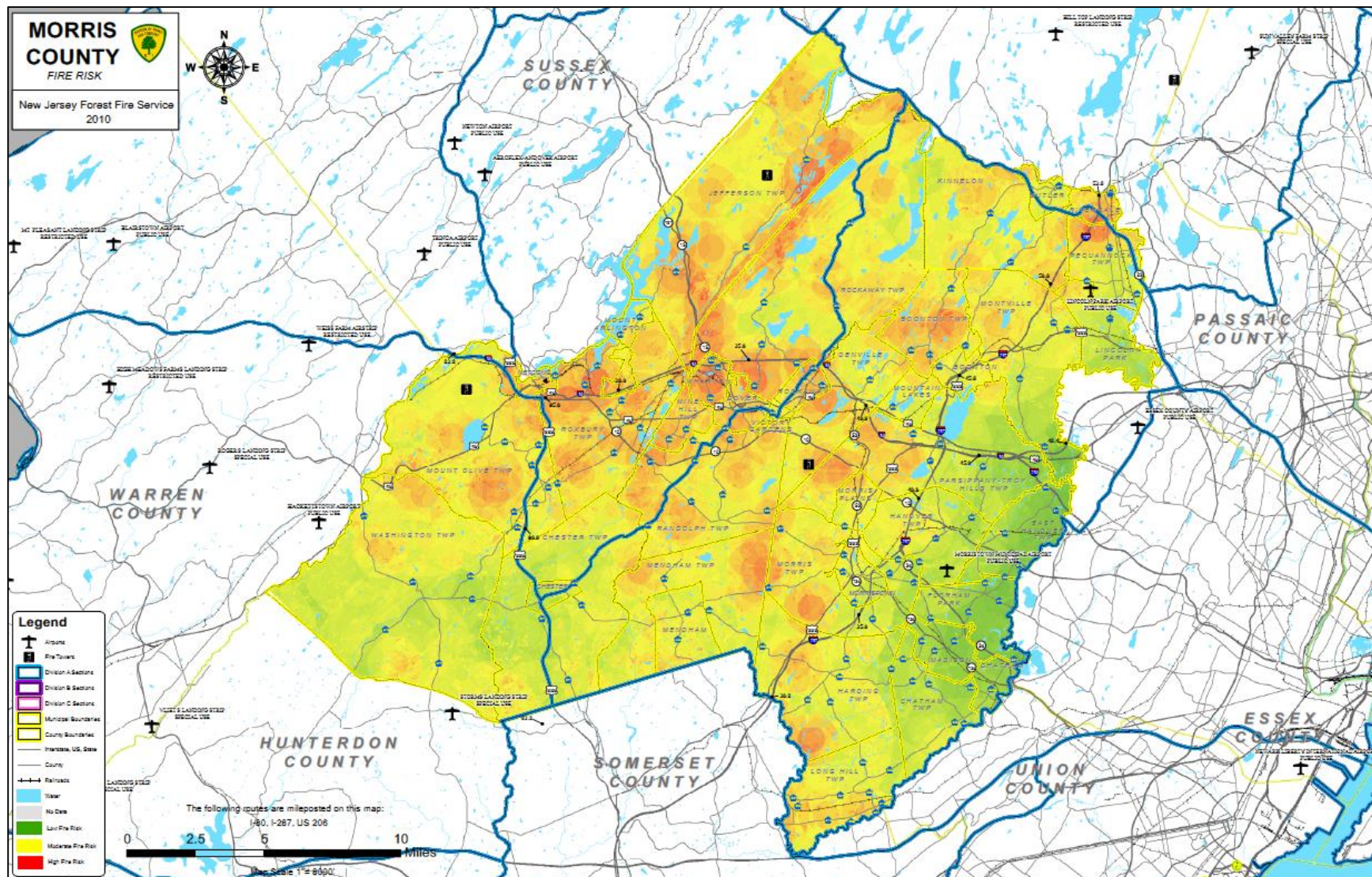
Figure 5.4.9-1. Wildfire Fuel Hazard for Morris County



Source: New Jersey Forest Fire Service 2010



Figure 5.4.9-2. Wildfire Risk for Morris County



Source: New Jersey Forest Fire Service 2010



Extent

The extent (that is, magnitude or severity) of wildfires depends on weather and human activity. NJFFS uses two indices to measure and monitor dryness of forest fuels and the possibility of fire ignitions becoming wildfires. These indices include the National Fire Danger Rating System's (NFDRS) Buildup Index (BUI), and the Keetch-Byram Drought Index (KBDI). Both are used for fire preparedness planning, which includes the following: campfire and burning restrictions, fire patrol assignments, fire lookout tower staffing, and readiness status for both observation and firefighting aircraft (NJFFS 2014).

The **Buildup Index (BUI)** is a number that reflects the combined cumulative effects of daily drying and precipitation in fuels with a 10-day time lag constant. The BUI can represent three to four inches of compacted litter or can represent up to six inches or more of loose litter (North Carolina Forest Service 2009).

The **Keetch-Byram Drought Index (KBDI)** is a drought index designed for fire potential assessment as defined by the U.S. Forest Service (USFS). It is a number representing the net effect of evapotranspiration and precipitation in producing cumulative moisture deficiency in deep duff and upper soil layers. It is a continuous index, relating to the flammability of organic material in the ground. The KBDI attempts to measure the amount of precipitation necessary to return the soil to full field capacity. It is a closed system ranging from 0 to 800 units and represents a moisture regime from 0 to 8 inches of water through the soil layer. Zero is the point of no moisture deficiency and 800 is the maximum drought that is possible. At any point along the scale, the index number indicates the amount of net rainfall that is required to reduce the index to 0, or saturation (USFS-Wildland Fire Assessment System 2014).

Additionally, the NFDRS is used to provide a measure of the relative seriousness of burning conditions and threat of fire throughout the United States. It allows fire managers to estimate the day's fire danger for a given area. The NFDRS uses a five color-coded system to help the public understand fire potential. The NFDRS is as follows:

Table 5.4.9-3. Fire Danger Rating and Color Code

Fire Danger Rating and Color Code	Description
Low (L) (Dark Green)	Fuels do not ignite readily from small firebrands although a more intense heat source, such as lightning, may start fires in duff or punky wood. Fires in open cured grasslands may burn freely a few hours after rain, but woods fires spread slowly by creeping or smoldering, and burn in irregular fingers. There is little danger of spotting.
Moderate (M) (Light Green or Blue)	Fires can start from most accidental causes, but with the exception of lightning fires in some areas, the number of starts is generally low. Fires in open-cured grasslands will burn briskly and spread rapidly on windy days. Timber fires spread slowly to moderately fast. The average fire is of moderate intensity, although heavy concentrations of fuel, especially draped fuel, may burn hot. Short-distance spotting may occur, but is not persistent. Fires are not likely to become serious and control is relatively easy.
High (H) (Yellow)	All fine dead fuels ignite readily and fires start easily from most causes. Unattended brush and campfires are likely to escape. Fires spread rapidly and short-distance spotting is common. High-intensity burning may develop on slopes or in concentrations of fine fuels. Fires may become serious and their control difficult unless they are attacked successfully while small.
Very High (VH) (Orange)	Fires start easily from all causes and, immediately after ignition, spread rapidly and increase quickly in intensity. Spot fires are a constant danger. Fires burning in light fuels may quickly develop high-intensity characteristics such as long-distance spotting and fire whirlwinds when they burn into heavier fuels.
Extreme (E) (Red)	Fires start quickly, spread furiously, and burn intensely. All fires are potentially serious. Development into high-intensity burning will usually be faster and occur from smaller fires than in the very high fire danger class. Direct attack is rarely possible and may be dangerous except immediately after ignition. Fires that develop headway in heavy slash (trunks, branches, and tree tops) or in conifer stands may be unmanageable while the extreme burning condition lasts. Under



Fire Danger Rating and Color Code	Description
	these conditions the only effective and safe control action is on the flanks until the weather changes or the fuel supply lessens.

Source: NJFFS 2014

Previous Occurrences and Losses

Many sources provided wildfire information regarding previous occurrences and losses associated with wildfire throughout New Jersey and Morris County. With so many sources reviewed for the purpose of this HMP Update, loss and impact information for many events could vary depending on the source. Therefore, the accuracy of monetary figures discussed is based only on the available information identified during research for this HMP update.

Between 1954 and 2015, New Jersey was included in two FEMA fire management assistance (FMA) declarations. Generally, these disasters cover a wide range of the State; therefore, the disaster may have impacted many counties. Morris County was not included in any FMA declarations. For this 2015 HMP update, wildfire events were summarized from 2008 to 2015 are identified in Appendix G. For events prior to 2008, please refer to the 2010 Morris County HMP. Please note that not all events that have occurred in Morris County are included due to the extent of documentation and the fact that not all sources may have been identified or researched. Loss and impact information could vary depending on the source. Therefore, the accuracy of monetary figures discussed is based only on the available information identified during research for this HMP Update.

Probability of Future Occurrences

Estimating the approximate number of wildfires to occur in Morris County is difficult to predict in a probabilistic manner. This is because a number of variable factors impact the potential for a fire to occur and because some conditions (for example, ongoing land use development patterns, location, fuel sources, and construction sites) exert increasing pressure on the WUI zone. Based on available data, urban fires and wildfires will continue to present a risk to Morris County. Given the numerous factors that can impact urban fire and wildfire potential, the likelihood of a fire event starting and sustaining itself should be gauged by professional fire managers on a daily basis.

In Section 5.3, the identified hazards of concern for Morris County were ranked. The probability of occurrence, or likelihood of the event, is one parameter used for ranking hazards. Based on historical records and input from the Planning Committee, the probability of occurrence for wildfire in the County is considered ‘frequent’ (likely to occur within 25 years, as presented in Table 5.3-3).

Climate Change Impacts

A gradual change in temperatures will alter the growing environment of many tree species throughout the United States and New Jersey, reducing the growth of some trees and increasing the growth of others. Tree growth and regeneration may be affected more by extreme weather events and climatic conditions than by gradual changes in temperature or precipitation. Warmer temperatures may lead to longer dry seasons and multi-year droughts, creating triggers for wildfires, insects, and invasive species. Increased temperature and change in precipitation will also affect fuel moisture during wildfire season and the length of time during which wildfires can burn during a given year (U.S. Department of Agriculture [USDA] 2012). Climate change may also increase the frequency of lightning flashes. A warmer atmosphere holds more moisture which is one of the key items for triggering a lightning strike. Lightning strikes cause approximately half the wildfires in the United States. If the frequency of lightning strikes increases, the potential for wildfires from these strikes also increases (Lee 2014). Wildfire



incidents are predicted to increase throughout the United States due to climate change, causing at least a doubling of areas burned within the next century (USDA 2012).

By the 2020s, the average annual temperature in New Jersey is projected to increase by 1.5°F to 3°F above the statewide baseline (1971 to 2000), which was 52.7°F. By 2050, the temperature is projected to increase 3°F to 5°F (Sustainable Jersey Climate Change Adaptation Task Force 2013). As for precipitation, Northern New Jersey's 1971-2000 precipitation average was over five inches (12%) greater than the average from 1895-1970 (Office of New Jersey State Climatologist). Average annual precipitation is projected to increase in the region by five-percent by the 2020s and up to 10% by the 2050s. Most of the additional precipitation is expected to come during the winter months (New York City Panel on Climate Change [NPCC] 2009).

As stated above, according to the temperature projections for Northern New Jersey, including Morris County, this area can expect warmer and drier conditions which may increase the frequency and intensity of wildfires. Higher temperatures are expected to increase the amount of moisture that evaporates from land and water. These changes have the potential to lead to more frequent and severe droughts, which, in turn, increases the likelihood of wildfires (U.S. EPA 2014; Northern Arizona University 2012).



5.4.9.2 Vulnerability Assessment

To understand risk, a community must evaluate what assets are exposed or vulnerable in the identified hazard area. For the wildfire hazard, the portions of Morris County in the low, moderate, high, very high and extreme danger rating zones have been identified as the hazard area. Therefore, all assets in the county (population, structures, critical facilities and lifelines), as described in the County Profile (Section 4), located in the hazard area are exposed and potentially vulnerable to wildfire. The following text evaluates and estimates the potential impact of the wildfire hazard on the County including:

- Overview of vulnerability
- Data and methodology used for the evaluation
- Impact on: (1) life, health and safety of residents, (2) general building stock, (3) critical facilities, (4) economy, and (5) future growth and development
- Effect of climate change on vulnerability
- Change of vulnerability as compared to that presented in the 2010 Morris County HMP
- Further data collections that will assist understanding this hazard over time

Overview of Vulnerability

Wildfire hazards can impact significant areas of land, as evidenced by wildfires throughout the State and United States over the past several years. Fire in urban areas has the potential for great damage to infrastructure, loss of life, and strain on lifelines and emergency responders because of the high density of population and structures that can be impacted in these areas. Wildfire, however can spread quickly, become a huge fire complex consisting of thousands of acres, and present greater challenges for allocating resources, defending isolated structures, and coordinating multi-jurisdictional response. If a wildfire occurs at a WUI, it can also cause an urban fire and in this case has the potential for great damage to infrastructure, loss of life, and strain on lifelines and emergency responders because of the high density of population and structures that can be impacted in these areas.

Potential losses from wildfire include human life, structures and other improvements, and natural resources. Given the immediate response times to reported wildfires, the likelihood of injuries and casualties is minimal. Smoke and air pollution from wildfires can be a health hazard, especially for sensitive populations including children, the elderly, and those with respiratory and cardiovascular diseases. Wildfire may also threaten the health and safety of those fighting the fires. First responders are exposed to the dangers from the initial incident and after-effects from smoke inhalation and heat stroke. In addition, wildfire can lead to ancillary impacts such as landslides in steep ravine areas and flooding caused by the impacts of silt in local watersheds.

Data and Methodology

The NJFFS uses Wildfire Fuel Hazard data to assign wildfire fuel hazard rankings across the State. This data, developed in 2009, is based upon NJDEP's 2002 Land Use/Land Cover datasets and NJDEP's 2002 10-meter Digital Elevation Grid datasets. Figure 5.4.9-1 presented earlier in this section illustrates the defined wildfire fuel hazard rankings for Morris County. For the wildfire hazard, the NJFFS Wildfire Fuel Hazard “extreme”, “very high” and “high” areas are identified as the wildfire hazard area. The statistics in the “moderate” to “low” areas are also reported.

To determine vulnerability, a spatial analysis was conducted using the NJFFS Fuel Hazard Area guidelines. When the analysis determined the hazard area would impact the area in a jurisdiction, or the location of critical facilities, these locations were deemed vulnerable to the hazard. The limitations of this analysis are recognized, and as such the analysis is only used to provide a general estimate.



Impact on Life, Health and Safety

As demonstrated by historic wildfire events in New Jersey and other parts of the country, potential losses include human health and life of residents and responders, structures, infrastructure and natural resources. In addition, wildfire events can have major economic impacts on a community from the initial loss of structures and the subsequent loss of revenue from destroyed business and decrease in tourism. The most vulnerable populations include emergency responders and those within a short distance of the interface between the built environment and the wildland environment.

Wildfires can cost thousands of taxpayer dollars to suppress and control and involve hundreds of operating hours on fire apparatus and thousands of volunteer man hours from the volunteer firefighters. There are also many direct and indirect costs to local businesses that excuse volunteers from work to fight these fires.

As a way to estimate the County's population vulnerable to the wildfire hazard, the population located within the NJFFS hazard areas were overlaid upon the 2010 Census population data (U.S. Census, 2010). The Census blocks with their center within the hazard area were used to calculate the estimated population exposed to the wildfire hazard. Table 5.4.9-4 summarizes the estimated population exposed by municipality.

Based on the analysis, 181,965 individuals, or 37% of the County's population, are exposed to low and moderate wildfire hazards, while 8,034, or 1.6% of the County's population, is exposed to high, very high and extreme wildfire hazards. Overall, the Township of Washington, Township of Montville and Borough of Mount Arlington have the greatest number of individuals located in the extreme/very high/high hazard areas.

Table 5.4.9-4. Estimated Vulnerable Population

Municipality	U.S. Census 2010 Population	Estimated Population Exposed			
		Extreme, Very High and High	% of Total Exposed	Moderate and Low	% of Total Exposed
Town of Boonton	8,347	276	3.3%	1,545	18.5%
Township of Boonton	4,263	0	0.0%	3,564	83.6%
Borough of Butler	7,539	176	2.3%	1,362	18.1%
Chatham Borough	8,962	0	0.0%	869	9.7%
Chatham Township	10,452	607	5.8%	3,303	31.6%
Chester Borough	1,649	0	0.0%	907	55.0%
Chester Township	7,838	424	5.4%	6,819	87.0%
Denville Township	16,635	0	0.0%	6,725	40.4%
Town of Dover	18,157	0	0.0%	1,727	9.5%
Township of East Hanover	11,157	0	0.0%	4,384	39.3%
Borough of Florham Park	11,696	0	0.0%	4,778	40.9%
Township of Hanover	13,712	213	1.6%	4,473	32.6%
Township of Harding	3,838	0	0.0%	2,780	72.4%
Township of Jefferson	21,314	544	2.6%	8,809	41.3%
Borough of Kinnelon	10,248	90	0.9%	7,038	68.7%
Borough of Lincoln Park	10,521	36	0.3%	5,057	48.1%
Township of Long Hill	8,702	688	7.9%	4,102	47.1%
Borough of Madison	15,845	0	0.0%	4,950	31.2%
Borough of Mendham	4,981	92	1.8%	3,248	65.2%
Township of Mendham	5,869	0	0.0%	4,360	74.3%
Township of Mine Hill	3,651	0	0.0%	1,260	34.5%



Table 5.4.9-4. Estimated Vulnerable Population

Municipality	U.S. Census 2010 Population	Estimated Population Exposed			
		Extreme, Very High and High	% of Total Exposed	Moderate and Low	% of Total Exposed
Township of Montville	21,528	1,034	4.8%	7,817	36.3%
Borough of Morris Plains	5,532	0	0.0%	1,094	19.8%
Township of Morris	22,306	384	1.7%	7,812	35.0%
Town of Morristown	18,411	0	0.0%	3,310	18.0%
Borough of Mount Arlington	5,050	1,034	20.5%	1,741	34.5%
Township of Mount Olive	28,117	477	1.7%	8,678	30.9%
Borough of Mountain Lakes	4,160	0	0.0%	1,368	32.9%
Netcong Borough	3,232	0	0.0%	9	0.3%
Township of Parsippany-Troy Hills	53,238	116	0.2%	13,386	25.1%
Township of Pequannock	15,540	295	1.9%	4,799	30.9%
Township of Randolph	25,736	47	0.2%	12,500	48.6%
Borough of Riverdale	3,559	0	0.0%	1,249	35.1%
Borough of Rockaway	6,438	0	0.0%	2,482	38.6%
Township of Rockaway	24,156	163	0.7%	11,449	47.4%
Township of Roxbury	23,324	241	1.0%	7,864	33.7%
Borough of Victory Gardens	1,520	0	0.0%	86	5.7%
Township of Washington	18,533	1,097	5.9%	13,200	71.2%
Borough of Wharton	6,522	0	0.0%	1,061	16.3%
Morris County (Total)	492,276	8,034	1.6%	181,965	37.0%

Source: 2010 US Census, NJFFS, 2013

Impact on General Building Stock

The most vulnerable structures to wildfire events are those located within the NJFFS identified extreme, very high or high fuel hazard areas. Buildings constructed of wood or vinyl siding are generally more likely to be impacted by the fire hazard than buildings constructed of brick or concrete. To estimate the buildings exposed to the wildfire hazard, the hazard areas were overlaid upon the building inventory in the County (Census block). The replacement cost value of the structures with their center in the hazard area were totaled. Table 5.4.9-5 summarizes the estimated building stock inventory exposed by municipality. The limitations of this analysis are recognized, and as such the analysis is only used to provide a general estimate.

Table 5.4.9-5. Building Stock Replacement Value Located in Wildfire Fuel Hazard Ranking Zones

Municipality	Total RV (Structure and Contents)	Building RV Exposed			
		Extreme, Very High and High	% of Total Exposed	Moderate and Low	% of Total Exposed
Town of Boonton	\$2,359,806,704	\$63,487,802	2.7%	\$55,697,619	2.4%
Township of Boonton	\$1,657,854,494	\$12,576,576	0.8%	\$651,512,197	39.3%
Borough of Butler	\$1,818,159,072	\$13,681,614	0.8%	\$87,057,199	4.8%
Chatham Borough	\$2,112,769,732	\$0	0.0%	\$19,664,914	0.9%
Chatham Township	\$3,234,872,840	\$10,128,893	0.3%	\$232,652,447	7.2%
Chester Borough	\$798,032,736	\$31,675,071	4.0%	\$74,980,528	9.4%
Chester Township	\$3,763,335,644	\$72,984,379	1.9%	\$2,711,723,949	72.1%

**Table 5.4.9-5. Building Stock Replacement Value Located in Wildfire Fuel Hazard Ranking Zones**

Municipality	Total RV (Structure and Contents)	Building RV Exposed			
		Extreme, Very High and High	% of Total Exposed	Moderate and Low	% of Total Exposed
Denville Township	\$5,687,212,965	\$3,199,576	0.1%	\$917,938,159	16.1%
Town of Dover	\$3,075,745,326	\$15,947,619	0.5%	\$125,510,839	4.1%
Township of East Hanover	\$5,401,896,233	\$7,373,530	0.1%	\$152,683,320	2.8%
Borough of Florham Park	\$3,991,843,257	\$25,246,809	0.6%	\$249,137,833	6.2%
Township of Hanover	\$6,582,774,313	\$9,214,044	0.1%	\$497,653,559	7.6%
Township of Harding	\$2,344,644,664	\$8,552,462	0.4%	\$1,792,722,890	76.5%
Township of Jefferson	\$5,074,333,318	\$8,244,752	0.2%	\$662,758,051	13.1%
Borough of Kinnelon	\$3,942,612,191	\$40,745,619	1.0%	\$1,611,259,843	40.9%
Borough of Lincoln Park	\$2,521,331,492	\$1,317,804	0.1%	\$168,531,602	6.7%
Township of Long Hill	\$2,686,329,094	\$3,037,165	0.1%	\$265,479,627	9.9%
Borough of Madison	\$4,038,218,735	\$72,336	0.0%	\$101,654,961	2.5%
Borough of Mendham	\$1,938,234,052	\$4,297,218	0.2%	\$727,704,738	37.5%
Township of Mendham	\$2,900,551,737	\$30,206,642	1.0%	\$2,004,689,132	69.1%
Township of Mine Hill	\$968,302,365	\$354,058	0.0%	\$90,118,135	9.3%
Township of Montville	\$7,935,508,932	\$32,405,933	0.4%	\$859,838,351	10.8%
Borough of Morris Plains	\$2,353,504,441	\$0	0.0%	\$139,373,348	5.9%
Township of Morris	\$8,423,230,635	\$8,917,766	0.1%	\$923,031,758	11.0%
Town of Morristown	\$4,131,251,475	\$0	0.0%	\$65,063,637	1.6%
Borough of Mount Arlington	\$1,698,506,114	\$86,455,656	5.1%	\$163,714,701	9.6%
Township of Mount Olive	\$7,726,519,709	\$53,149,378	0.7%	\$1,135,474,009	14.7%
Borough of Mountain Lakes	\$1,470,833,586	\$0	0.0%	\$80,369,202	5.5%
Netcong Borough	\$936,477,404	\$806,433	0.1%	\$8,295,822	0.9%
Township of Parsippany-Troy Hills	\$14,262,637,338	\$123,693,816	0.9%	\$660,069,350	4.6%
Township of Pequannock	\$4,903,988,440	\$1,053,540	0.0%	\$436,603,975	8.9%
Township of Randolph	\$8,283,021,151	\$22,067,293	0.3%	\$1,228,848,290	14.8%
Borough of Riverdale	\$1,246,580,332	\$7,175,865	0.6%	\$146,053,651	11.7%
Borough of Rockaway	\$1,804,154,071	\$0	0.0%	\$30,273,285	1.7%
Township of Rockaway	\$7,782,228,135	\$90,707,266	1.2%	\$963,194,362	12.4%
Township of Roxbury	\$6,601,093,651	\$14,271,679	0.2%	\$495,923,016	7.5%
Borough of Victory Gardens	\$138,840,857	\$0	0.0%	\$0	0.0%
Township of Washington	\$6,580,308,267	\$37,016,693	0.6%	\$3,365,895,324	51.2%
Borough of Wharton	\$1,699,397,922	\$0	0.0%	\$13,812,122	0.8%
Morris County (Total)	\$154,876,943,422	\$840,065,289	0.5%	\$23,916,965,743	15.4%

Source: HAZUS-MH 2.1; NJFFS, 2013

Notes: RV = Replacement Value

Impact on Critical Facilities

It is recognized that a number of critical facilities are located in the wildfire hazard area, and are also vulnerable to the threat of wildfire. Many of these facilities are the locations for vulnerable populations (i.e., schools, senior facilities) and responding agencies to wildfire events (i.e., fire, police). Table 5.4.9-6 and 5.4.9-7 summarize the critical facilities located within the wildfire hazard area by jurisdiction.



Table 5.4.9-6. Facilities in Moderate and Low Wildfire Fuel Hazard Ranking Zones in Morris County

Municipality	Facility Types																	
	Bus	Communication	Dam	DPW	Electric Substation	EMS	Emergency Operation Center	Fire Station	Hazardous Material	Library	Municipal Hall	Natural Gas	Nuclear	Potable Water Facility	Rail Facility	School	Shelter	Wastewater Facility
Town of Boonton	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Township of Boonton	0	0	4	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Borough of Butler	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chatham Borough	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	1
Chatham Township	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Chester Borough	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0
Chester Township	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Denville Township	0	1	2	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
Town of Dover	1	0	0	1	0	0	0	0	0	0	0	0	0	0	2	0	0	0
Township of East Hanover	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Borough of Florham Park	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Township of Hanover	0	1	1	3	0	0	0	0	0	0	0	1	0	0	0	0	0	2
Township of Harding	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Township of Jefferson	0	0	7	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Borough of Kinnelon	0	0	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Borough of Lincoln Park	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	2
Township of Long Hill	0	0	0	1	0	0	0	0	0	0	0	0	0	0	3	1	0	2
Borough of Madison	0	1	0	1	0	0	0	0	0	0	0	0	0	0	1	2	0	0
Borough of Mendham	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Township of Mendham	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	1	1
Township of Mine Hill	0	0	1	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0
Township of Montville	0	0	3	0	0	0	0	0	1	0	0	0	0	0	1	2	0	0
Borough of Morris Plains	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0
Township of Morris	0	0	0	1	0	0	0	1	1	0	0	0	0	0	1	0	1	2
Town of Morristown	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Borough of Mount Arlington	0	0	0	1	0	0	0	0	0	1	0	0	0	0	1	0	0	0
Township of Mount Olive	0	0	1	1	0	0	0	0	0	0	0	0	0	0	1	2	0	2



Municipality	Facility Types																	
	Bus	Communication	Dam	DPW	Electric Substation	EMS	Emergency Operation Center	Fire Station	Hazardous Material	Library	Municipal Hall	Natural Gas	Nuclear	Potable Water Facility	Rail Facility	School	Shelter	Wastewater Facility
Borough of Mountain Lakes	0	0	2	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0
Netcong Borough	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0
Township of Parsippany-Troy Hills	0	1	3	1	0	1	0	0	0	0	0	0	0	2	0	2	0	2
Township of Pequannock	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	2	0	0
Township of Randolph	0	0	2	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Borough of Riverdale	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0
Borough of Rockaway	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Township of Rockaway	0	0	7	2	1	0	0	0	1	0	0	1	1	0	0	1	0	0
Township of Roxbury	0	0	0	1	0	0	1	0	0	0	1	0	0	0	1	1	0	1
Borough of Victory Gardens	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Township of Washington	0	0	2	1	0	0	0	0	0	1	0	0	0	0	0	0	0	3
Borough of Wharton	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Morris County (Total)	2	4	49	21	2	6	1	3	7	4	1	3	1	2	17	16	2	19

Source: NJFFS, 2013, Morris County, HAZUS-MH

Note: DPW – Department of Public Works

EMS – Emergency Medical Services

Table 5.4.9-7. Facilities in Extreme, Very High, or High Wildfire Fuel Hazard Ranking Zones in Morris County

Municipality	Facility Types	
	Dam	Hazardous Material
Town of Boonton	1	0
Township of Boonton	0	1
Borough of Butler	0	0
Chatham Borough	0	0
Chatham Township	0	0
Chester Borough	0	0



Municipality	Facility Types	
	Dam	Hazardous Material
Chester Township	0	0
Denville Township	0	0
Town of Dover	0	0
Township of East Hanover	0	1
Borough of Florham Park	0	0
Township of Hanover	0	0
Township of Harding	0	0
Township of Jefferson	0	0
Borough of Kinnelon	1	0
Borough of Lincoln Park	0	0
Township of Long Hill	0	0
Borough of Madison	0	0
Borough of Mendham	0	0
Township of Mendham	0	0
Township of Mine Hill	0	0
Township of Montville	0	0
Borough of Morris Plains	0	0
Township of Morris	0	0
Town of Morristown	0	0
Borough of Mount Arlington	0	0
Township of Mount Olive	1	0
Borough of Mountain Lakes	0	0
Netcong Borough	0	0
Township of Parsippany-Troy Hills	0	0
Township of Pequannock	0	0
Township of Randolph	1	0
Borough of Riverdale	0	0
Borough of Rockaway	0	0
Township of Rockaway	0	0
Township of Roxbury	0	0
Borough of Victory Gardens	0	0
Township of Washington	0	0
Borough of Wharton	0	0
Morris County (Total)	4	2

Source: NJFFS, 2013, Morris County, HAZUS-MH



Impact on Economy

Wildfire events can have major economic impacts on a community from the initial loss of structures and the subsequent loss of revenue from destroyed business and decrease in tourism. Wildfires can cost thousands of taxpayer dollars to suppress and control and involve hundreds of operating hours on fire apparatus and thousands of volunteer man hours from the volunteer firefighters. There are also many direct and indirect costs to local businesses that excuse volunteers from working to fight these fires.

Future Growth and Development

Areas targeted for potential future growth and development in the next five years have been identified across Morris County at the municipal level. Refer to the jurisdictional annexes in Volume II of this HMP. It is anticipated that any new development and new residents in the extreme, very high or high fuel hazard areas will be exposed to the wildfire hazard.

Effect of Climate Change on Vulnerability

According to the U.S. Fire Service (USFS), climate change will likely alter the atmospheric patterns that affect fire weather. Changes in fire patterns will, in turn, impact carbon cycling, forest structure, and species composition. Climate change associated with elevated greenhouse gas concentrations may create an atmospheric and fuel environment that is more conducive to large, severe fires (USFS, 2011). Under a changing climate, wildfires are expected to increase by 50% across the U.S. (USFS, 2013).

Fire interacts with climate and vegetation (fuel) in predictable ways. Understanding the climate/fire/vegetation interactions is essential for addressing issues associated with climate change that include:

- Effects on regional circulation and other atmospheric patterns that affect fire weather
- Effects of changing fire regimes on the carbon cycle, forest structure, and species composition, and
- Complications from land use change, invasive species and an increasing wildland-urban interface (USFS, 2011).

It is projected that higher summer temperatures will likely increase the high fire risk by 10 to 30-percent. Fire occurrence and/or area burned could increase across the U.S. due to the increase of lightning activity, the frequency of surface pressure and associated circulation patterns conducive to surface drying, and fire-weather conditions, in general, which is conducive to severe wildfires. Warmer temperatures will also increase the effects of drought and increase the number of days each year with flammable fuels and extending fire seasons and areas burned (USFS, 2011).

Future changes in fire frequency and severity are difficult to predict. Global and regional climate changes associated with elevated greenhouse gas concentrations could alter large weather patterns, thereby affecting fire-weather conducive to extreme fire behavior (USFS, 2011).

Change of Vulnerability

A wildfire exposure analysis was not conducted as part of the 2010 HMP risk assessment. The updated vulnerability assessment provides a more current exposure analysis for the County.

Additional Data and Next Steps

As the custom building inventory is updated additional building attributes regarding the construction of structures, such as roofing material, fire detection equipment, structure age, etc. may be incorporated as available. As stated earlier, buildings constructed of wood or vinyl siding are generally more likely to be



impacted by the fire hazard than buildings constructed of brick or concrete. The proximity of these building types to the fuel hazard areas should be identified for further evaluation. Development and availability of such data would permit a more detailed estimate of potential vulnerabilities, including loss of life and potential structural damages.